

by fasting, is a *remarkable* contribution to our knowledge of diabetes. With cases that are in imminent danger of coma, in which each day may be the last, a measure that promises *any success at all* is of the greatest value; and here, I believe, is the special field for the fasting method. That fasting in itself may be a dangerous procedure, we recognize; as are also serious surgical measures. There are occasions when we have scant choice. That the fasting treatment is not devoid of hazard we must recognize, and it throws upon us the responsibility to use this method only when other and less drastic methods are inadequate to effect the desired result; and to recognize that fasting is, again, like many surgical measures, suited best for use in well-equipped hospitals, in which careful observation and frequent tests of blood, urine, and alveolar air are made as part of the routine. Only in this way can dangerous reactions be foreseen and requisite measures be instituted. The treatment is *fundamentally* a treatment for grave acidosis.

Finally, then, I can summarize my conclusions: Every case of diabetes demands the most careful study not only of the diabetic state, but also of all conditions which may influence the future health of the patient. Infections must be kept in mind as the constant danger. Early cases must be kept free of glycosuria in order to raise resistance and to avoid the development of acidosis. This can be done even in face of acidosis by the use of restricted low diets. With advanced cases glycosuria must be controlled in order to regain normal weight and vigor. When there is grave acidosis this also can now with many cases be successfully abolished. The chief difficulty in treating all diabetics is the necessity of constant vigilance over years.

THE EFFECT OF EXERCISE UPON THE CARBOHYDRATE TOLERANCE IN DIABETES.

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It has been known for many years that exercise increases the carbohydrate tolerance in the milder forms of diabetes, although in severe types of the disease it lowers the tolerance or may even precipitate coma. This therapeutic measure has been neglected, probably, because of the lack of a practical system of exercise the effects of which on patients could be checked up by an accurate test of the heart's functional capacity.

Our experience in treating patients with cardiac insufficiency by means of graduated exercise controlled by such a test, which we have described elsewhere,¹ suggested an experiment with these exercises on a few selected cases of diabetes.

The apparatus used consisted of dumb-bells weighing from 10 to 40 pounds each, and steel bars varying between 25 and 80 pounds in weight, with which different series of movements were carried out. The exercises were of a concentrated form, and were given an hour daily, three days in the week, generally in the late afternoon. Each series of movements lasted from thirty to one hundred and twenty seconds, and six to eight were given at each exercise period, so that the actual working time varied between four and sixteen minutes for the hour.

The first patient was a professional man, aged forty-two years, suffering from a mild form of diabetes. In November, 1909, an insurance company had discovered sugar in the urine. His tolerance at that time was 360 grams of white bread in twenty-four hours. His urine was kept practically sugar-free for the next four years. In June, 1913, his tolerance had decreased to 150 to 180 grams of white bread in the twenty-four hours. He was then put on one egg and vegetable day weekly. In October, 1913, his tolerance was still 150 grams, but by September, 1914, it had decreased to 120 grams.

On September 24, 1914, when the exercise course was started, the patient's physical examination was negative; he weighed 141 pounds and his lung capacity was 284 cubic inches.

The following table summarizes the results in this patient:

Date.	Quantity of carbohy- drate (white bread) in twenty-four hours (grams).	Quantity of glu- cose in twenty- four hours' urine.	Approximate amount of work at each period in foot- pounds.
September 23, 1914 . . .	120	trace	14,900
October 19, 1914 . . .	150	none	
November 2, 1914 . . .	180	trace	21,700
November 9, 1914 . . .	180	none	
November 16, 1914 . . .	210	trace	
November 23, 1914 . . .	225	none	
November 30, 1914 . . .	240	3.1 grams	36,500
December 14, 1914 . . .	225	none	
February 1, 1915 . . .	240	none	40,000
March 17, 1915 . . .	270	trace	
April 24, 1915 . . .	270	trace	
May 12, 1915 . . .	270	trace	

During the period noted above the patient's daily allowance of carbohydrate was always kept well below his tolerance. An egg and vegetable day was given once weekly. His tolerance increased from less than 120 grams on September 23, 1914, to 240 grams on February 1, 1915. Although his exercises were continued until June 1, 1915, we never could get his capacity much beyond that

¹ Barringer and Teschner, Arch. Int. Med., 1915, xvi, p. 795.

figure. He gained six and one-fourth pounds in weight and his lung capacity increased from 284 cubic inches to 300 cubic inches. His general health and ability to do his work without fatigue improved markedly.

These results are truly astonishing when we consider that the actual working time of our patient during his course of fifty exercise periods amounted to between four and sixteen hours.

July 1, 1915, he stopped the exercises and in their stead lead an active outdoor life in the country for ten weeks. His exercise there was carried out quite systematically, and consisted chiefly in chopping down trees, chopping wood, and using a pick on a clam-shell road. He continued his weekly egg and vegetable day and kept his daily intake of carbohydrate well within his tolerance. To our surprise the tolerance decreased steadily, as is seen by the following table:

Date.	Quantity of carbohydrate (white bread) in twenty-four hours. (grams).	Quantity of glucose in twenty-four hour-specimen.
August 3, 1915	225	trace
August 13, 1915	195	trace
August 31, 1915	165	trace
September 20, 1915	120	none
October 5, 1915	150	none
November 21, 1915	180	trace
December 5, 1915	180	trace
December 19, 1915	195	trace
January 2, 1916	195	trace

On September 20 the patient returned to the city and resumed his dumb-bell and bar exercises. Through a misunderstanding he did them each day before breakfast, but on December 5 this was remedied. Also for three weeks they were omitted on account of an attack of lumbago. He now seems (December 19) to be approaching his former tolerance of 240 grams.

The second case selected was one of moderate severity. The patient was a professional man, aged thirty years, in whom a glycosuria had been discovered in 1912. Since then, in spite of following quite conscientiously a treatment initiated by Dr. von Noorden, his urine never has been sugar-free.

The following table summarizes our results:

Date.	Diet.	Glucose in twenty-four hour-specimen.	Exercise.
February 28, 1915	6 days carbohydrate-free	7.9 gms. (acetone +)	
March 16, 1915	60 gms. white bread	14.4 gms. (acetone 0)	
April 1, 1915	30 gms. white bread 150 gms. oatmeal	6.4 gms.	Three hours weekly, began March 20.
April 17, 1915	30 gms. white bread 150 gms. oatmeal	4.6 gms.	
May 1, 1915	30 gms. white bread 150 gms. oatmeal	10.2 gms.	
May 7, 1915	Egg and vegetable day	6.3 gms.	